Claims

1. Control arrangement (2) for occupant protection means in a motor vehicle (1),
- with a sensor field (5) with at least two acceleration sensors (17, 18, 19 or 19, 20) being assigned to the control arrangement (2), said acceleration sensors (17, 18, 19 or 19, 20) having at least two sensor elements (g-cells 11), which allow acceleration sensing along three sensitivity axes (u, v, w or w, x, y);
- with the sensitivity axes (u, v, w or w, x, y) of the sensor elements (11) of the acceleration sensors (17, 18, 19 or 19, 20) spanning a plane, which after the control arrangement (2) has been integrated in a motor vehicle (1) is essentially parallel to a plane defined by a longitudinal axis of the vehicle (A-A') and a transverse axis of the vehicle (B-B');
- with at least one evaluation device (3) comprising
  - for normal and crash mode
    - a safing routine to test the plausibility of all output signals (a_u, a_v, a_w and a_w, a_x, a_y) of the sensors (17, 18, 19 or 19, 20) by creating a weighted sum (Σ_g) from the output signals (a_u, a_v, a_w and a_w, a_x, a_y); and
    - a crash routine to evaluate the output signals (a_u, a_v, a_w and a_w, a_x, a_y); and
  - for test mode
    - a test routine, which sends a test signal (t) to at least two acceleration sensors (17, 18, 19 or 19, 20) to generate output signals (a_u, a_v, a_w and a_w, a_x, a_y) to test the operation of the sensors (17, 18, 19 or 19, 20);

characterized in that
- at least one test signal (t) can be modified by means of a weighting means (16) by a predefinable weighting factor (k_w) such that at least one acceleration sensor (19) outputs a

weighted output signal (a_{wg}); and
- during the test routine the output signals (a_u, a_v, a_{wg} and a_{wg}, a_x, a_y) of the acceleration sensors (17, 18, 19 or 19, 20) arranged in the sensor field (5) can be processed according to the safing routine,
- with the weighted sum (Σ_g) of the output signals (a_u, a_v, a_{wg} and a_{wg}, a_x, a_y) producing a predefined value when the acceleration sensors (17, 18, 19 or 19, 20) are capable of operation; and
- with the possibility of determining error-free operation of the control arrangement (2), when the weighted sum (Σ_g) of the output signals (a_u, a_v, a_{wg} and a_{wg}, a_x, a_y) actually supplied during the test routine approximately produces the predefined value.

2. Control arrangement (2) according to claim 1, characterized by a sensor field (5) with three acceleration sensors (17, 18, 19) each comprising a sensor element (11) for one sensitivity direction (u, v, w or w, x, y) each.

3. Control arrangement according to claim 1, characterized by a sensor field (5) with a first acceleration sensor (19) with a sensor element (11) for a predefined sensitivity direction (w) and by a second acceleration sensor with two sensor elements (11) for two predefined sensitivity directions (x, y).

4. Control arrangement according to claim 1, characterized by a first acceleration sensor (19) with a sensor element (11) for a predefined sensitivity direction (w) and by a second acceleration sensor (20) with a sensor element (11) for two predefined sensitivity directions (x, y).

5. Control arrangement (2) according to one of the preceding claims, characterized in that the weighting means (16) is part of the evaluation device (3) and/or part of the acceleration sensor(s) (17, 18, 19, 20).

6. Control arrangement (2) according to one of the preceding claims, characterized in that the weighting means (16) comprises a plurality of so-called test fingers, a voltage-reducing component such as a resistor or a voltage-increasing component such as a charging pump or another suitable electronic and/or mechanical component.

7. Method for testing the operation of a control arrangement (2) for occupant protection means (7, 8, 9, 10) in a motor vehicle (1), in particular a control arrangement (2) according to one of the preceding claims,

- with a sensor field (5) with at least two acceleration sensors (17, 18, 19 or 19, 20) being assigned to the control arrangement (2), said acceleration sensors (17, 18, 19 or 19, 20) having at least two sensor elements (g-cells 11), which allow acceleration sensing along three sensitivity axes (u, v, w or w, x, y);
- with the sensitivity axes (u, v, w or w, x, y) of the sensor elements (11) of the acceleration sensors (17, 18, 19 or 19, 20) spanning a plane, which after the control arrangement (2) has been integrated in a motor vehicle (1) is essentially parallel to a plane defined by a longitudinal axis of the vehicle (A-A') and a transverse axis of the vehicle (B-B');
- with the control arrangement (2) having at least one evaluation device (3), which
  - in normal and crash mode
    - tests the plausibility of all output signals (a_u, a_v, a_w and a_w, a_x, a_y) of the sensors (17, 18, 19 or 19, 20) by means

of a safing algorithm by creating a weighted sum (Σ_g) from the output signals (a_u, a_v, a_w and a_w, a_x, a_y) and

- evaluates the output signals (a_u, a_v, a_w and a_w, a_x, a_y) by means of a crash discrimination algorithm; and

- in test mode

- sends a test signal (t) to at least two acceleration sensors (17, 18, 19 or 19, 20) to generate output signals (a_u, a_v, a_w and a_w, a_x, a_y) to test the operation of the sensors (17, 18, 19 or 19, 20);

characterized in that

- at least one test signal (t) is subjected to a weighting (k_w) such that at least one acceleration sensor (19) outputs a weighted output signal (a_{wg}); and

- in test mode the output signals (a_u, a_v, a_{wg} and a_{wg}, a_x, a_y) of the acceleration sensors (17, 18, 19 or 19, 20) arranged in the sensor field (5) can be processed according to the safing algorithm,

- with the weighted sum (Σ_g) of the output signals (a_u, a_v, a_{wg} and a_{wg}, a_x, a_y) producing a predefined value when the acceleration sensors (17, 18, 19 or 19, 20) are capable of operation; and

- with the possibility of determining error-free operation of the control arrangement (2), when the weighted sum (Σ_g) of the output signals (a_u, a_v, a_{wg} and a_{wg}, a_x, a_y) actually supplied in test mode approximately produces the predefined value.

8. Method according to claim 7, characterized in that at least one of the output signals (a_u, a_v, a_w and a_w, a_x, a_y) is compared with a threshold value (SW), with the safing algorithm only being released when at least one of the output signals (a_u, a_v, a_w and a_w, a_x, a_y) exceeds the threshold value

(SW).

9. Method according to claim 7 or 8, characterized in that the test signal (t) is supplied to the control circuit (15) of the sensor (17, 18, 19, 20) such that an output signal (a_u, a_v, a_w and a_w, a_x, a_y) is electronically generated or simulated.

10. Method according to claim 7 or 8, characterized in that the test signal (t) is supplied to the sensor element (g-cell 11) of the sensor (17, 18, 19, 20) such that the seismic mass (12) of the sensor element (11) is displaced in a predefined direction (u, v, w, x, y).

11. Method according to one of claims 7 to 10, characterized by the use of a so-called safing sensor (19) with a sensor element (11), the sensitivity axis (w) of which is arranged at an oblique angle to two sensitivity axes (x, y) that are perpendicular to each other, in particular at an angle of 45°, 135° or 225° to the mutually perpendicular sensitivity axes (x and y).

12. Method according to claim 11, characterized by the use of two sensors (17, 18) each comprising a sensor element (11) each with a sensitivity axis (x, y) perpendicular to the other.

13. Method according to claim 11, characterized by the use of a so-called x-y sensor comprising two sensor elements (11), each with a sensitivity axis (x, y) perpendicular to the other.

14. Method according to claim 11, characterized by the use of a so-called x-y sensor (20) comprising a sensor element (11)

with two sensitivity axes (x, y) perpendicular to each other.

15. Method according to claim 9 or 10 and one of claims 11 to 14, characterized in that the seismic masses (12) of two sensor elements (11) are displaced in a predefined direction or corresponding signals are generated or simulated electronically, in particular

- the seismic mass (12) of the sensor element (11) of a first acceleration sensor (19) is displaced with weighted force in the opposite direction to its sensitivity axis (w) or a corresponding signal (a_{wg}) is generated or simulated electronically, and

- the seismic mass (12) of the sensor element (11) of a second acceleration sensor (17, 18; 20) is displaced with unweighted force in the direction of its sensitivity axis (x or y) or a corresponding signal (a_x or a_y) is generated or simulated electronically;

- or vice versa.

16. Method according to claim 15, characterized by a weighting factor (kw) of half the root of two ($\frac{1}{2} * \sqrt{2} \approx 0.707$).

17. Method according to claim 9 or 10 and one of claims 11 to 14, characterized in that the seismic masses (12) of three sensor elements (11) are displaced in a predefined direction or corresponding signals are generated or simulated electronically, in particular

- the seismic mass (12) of the sensor element (11) of a first acceleration sensor (19) is displaced with weighted force in the opposite direction to its sensitivity axis (w) or a corresponding signal (a_{wg}) is generated or simulated electronically;

- the seismic mass (12) of the sensor element (11) of a second

acceleration sensor (17, 18; 20) is displaced with unweighted force in the direction of its sensitivity axis (x or y; u) or a corresponding signal (a_x or a_y; a_y) is generated or simulated electronically; and

- the seismic mass (12) of the second or a third sensor element (11) of the acceleration sensors (11, 12, 13, 14) is displaced with unweighted force in the direction of its sensitivity axis (y or x; v) or a corresponding signal (a_y or a_x; a_v) is generated or simulated electronically;
- or vice versa.

18. Method according to claim 17, characterized by a weighting factor (k) of the root of two ($\sqrt{2} \approx 1.41$).

19. Method according to one of claims 7 to 10, characterized by a star-shaped arrangement of three sensors (17, 18, 19), each comprising a sensor element (11) with sensitivity axes (u, v, w) arranged at an angle to each other, in particular each with a sensitivity axis (u, v, w) at an angle of 120° to each other.

20. Method according to claim 9 or 10 and 19, characterized in that the seismic masses (12) of three sensor elements (11) are displaced in a predefined direction or corresponding signals are generated or simulated electronically, in particular according to the features of claim 17.

21. Method according to claim 20, characterized by a weighting factor of 2.

22. Method according to one of the preceding method claims, characterized in that the weighted sum (Σ_g) of the output signals (a_u, a_v, a_{wg} and a_{wg}, a_x, a_y) must be approximately zero,

in order to diagnose error-free operation of the control arrangement (17, 18, 19 or 19, 20) in test mode.

23. Method according to one of claims 10 to 22, characterized by a capacitive test displacement of the seismic mass (12) of the acceleration sensors (17, 18, 19 or 19, 20).